MarsOasis - An Efficient Autonomously Controlled Martian Crop Production System, Phase I

Completed Technology Project (2018 - 2019)

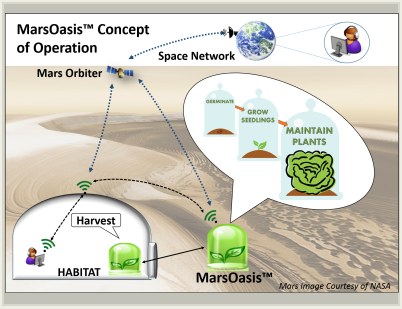
Project Introduction

The MarsOasis™ cultivation system is a versatile, autonomous, environmentally controlled growth chamber for food provision on the Martian surface. MarsOasis™ integrates a wealth of prior research and Mars growth chamber concepts into a complete system design and operational prototype. MarsOasis™ includes several innovative features relative to the state of the art space growth chambers. It can operate on the Mars surface or inside of a habitat. The growth volume maximizes growth area and supports a variety of crop sizes, from seeding through harvest. It utilizes in-situ CO_2 from the Mars atmosphere. Hybrid lighting takes advantage of natural sunlight during warmer periods, and supplemental LEDs during extreme cold, low light, or indoor operation. Recirculating hydroponics and humidity recycling minimize water loss. The structure also supports a variety of hydroponic nutrient delivery methods, depending on crop needs. The growth chamber uses solar power when outside, with deployable solar panels that stow during dust storms or at night. It can also use power from the habitat or other external sources. The growth chamber is mobile, so that the crew can easily relocate it. Autonomous environmental control manages crop conditions reducing crew time for operation. Finally, remote teleoperation allows pre-deployment, prior to crew arrival. This project directly addresses the NASA STTR technology area T7.02 "Space Exploration Plant Growth" and will be a major step towards closed-loop, sustainable living systems for space exploration. This collaborative effort between Space Lab Technologies, LLC and the Bioastronautics research group from the CU Boulder Smead Aerospace Engineering Sciences Department combines conceptual design, modeling & analysis, experimentation, and prototyping to demonstrate feasibility and prepare for future development of a demonstration unit.

Anticipated Benefits

MarsOasis™ provides fresh food to spacecraft crew on the Martian surface. The membrane contactor design allows highly selective CO_2 capture and regenerable CO_2 control in growth chambers, space habitats, or even spacesuits. The robotic harvesting arm can be used in plant chambers or other glove box applications. Finally, the deployable dome material might be used in a variety of applications including spacecraft greenhouses, habitat plumbing systems, or non-load bearing habitat structures.

MarsOasis™ could enable populations in water and nutrient scarce regions to grow fresh vegetables. A simplified version may be attractive in urban areas as year-round roof-top gardens. The sensor suite and control software could improve yield and reduce costs in horticulture facilities. Finally, the membrane contactor design could scrub CO_2 from power plants and confined atmospheres (e.g. submarines) more efficiently and at a lower cost than traditional systems.



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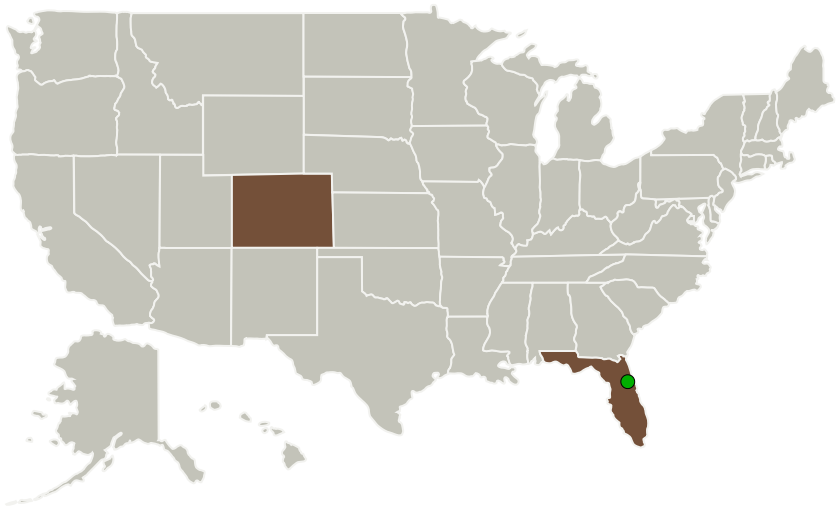
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Space Lab Technologies, LLC	Lead Organization	Industry Small Disadvantaged Business (SDB)	Pinecliffe, Colorado
Kennedy Space Center(KSC)	Supporting Organization	NASA Center	Kennedy Space Center, Florida
University of Colorado Boulder	Supporting Organization	Academia	Boulder, Colorado

Primary U.S. Work Locations	
Colorado	Florida

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Space Lab Technologies, LLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

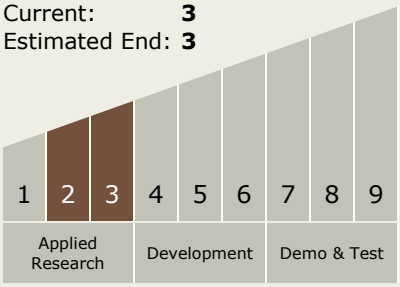
Carlos Torrez

Principal Investigator:

Christine Escobar

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



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Project Transitions

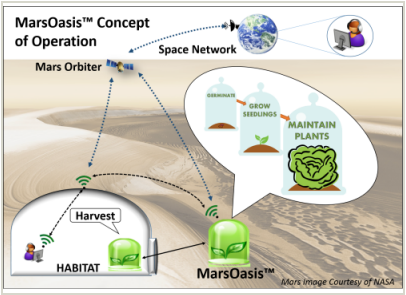
July 2018: Project Start

August 2019: Closed out

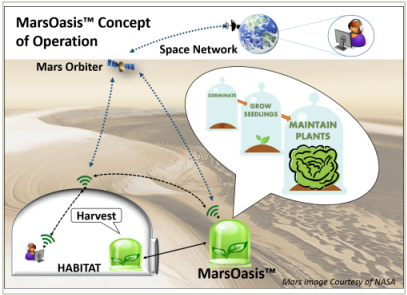
Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/137861)*

Images



Final Summary Chart Image
MarsOasis - An Efficient Autonomously Controlled Martian Crop Production System, Phase I *(https://techport.nasa.gov/image/129943)*



Project Image
MarsOasis - An Efficient Autonomously Controlled Martian Crop Production System, Phase I *(https://techport.nasa.gov/image/132043)*

Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems
  - TX06.3 Human Health and Performance
    - TX06.3.5 Food Production, Processing, and Preservation

Target Destination

Mars